**Inpatient Hyperglycemia - Adult**

Disclaimer: This algorithm has been developed for MD Anderson using a multidisciplinary approach considering circumstances particular to MD Anderson’s specific patient population, services and structure, and clinical information. This is not intended to replace the independent medical or professional judgment of physicians or other health care providers in the context of individual clinical circumstances to determine a patient's care. This algorithm should not be used to treat pregnant women.

**PRESENTATION**

- Patient with known diabetes or blood glucose ≥ 200 mg/dL

  - Check hemoglobin A1c if not completed within the last 3 months
  - Check fructosamine level if patient is severely anemic or has had a transfusion within the past 3 months
  - Begin POC glucose monitoring

**INITIAL EVALUATION**

- See Hyperglycemic Emergency Management (DKA/HHS) – Adult algorithm

- Type 1 diabetes or history of DKA or insulin pump or history of total pancreatectomy

- Type 2 diabetes or steroid induced diabetes/hyperglycemia

- No history of diabetes

**TREATMENT**

- Page Endocrinology-Diabetes for urgent consultation which requires clinician to clinician communication

- See Page 2

- See Page 4

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**Note:** Insulin dose adjustments should be made based on the individual patient’s glucoses. Refer to the Hypoglycemia Management algorithm, as indicated.

**DKA** = diabetic ketoacidosis  
**HHS** = hyperosmolar hyperglycemic state  
**POC** = point of care

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1. A1c may be inaccurate if recent blood transfusion within the past three months or severe anemia. Consider fructosamine level for patients with recent blood transfusion or severe anemia and who have normal renal and hepatic function.

2. Diagnostic criteria:  
   - DKA: blood glucose > 250 mg/dL and arterial pH < 7.3 or bicarbonate < 15 mEq/L, and moderate ketonuria or ketonemia  
   - [Note: Blood glucose may be lower than expected in patients on SGLT-2 inhibitors (e.g., empagliflozin, canagliflozin, ertugliflozin and dapagliflozin)]  
   - HHS: blood glucose > 600 mg/dL and arterial pH > 7.3 or bicarbonate > 15 mEq/L, and minimal ketonuria and ketonemia
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Note: Insulin dose adjustments should be made based on the individual patient’s glucose levels. Refer to the Hypoglycemia Management algorithm, as indicated.

### PRESENTATION
Type 2 diabetes or steroid induced diabetes/hyperglycemia

- Stop high-risk home medications
- Hold metformin if eGFR < 45 mL/minute/1.73 m²

### ASSESSMENT
- Is patient on > 100 units of insulin daily or on Humulin U-500 insulin at home?
  - Yes → Consult Endocrinology-Diabetes
  - No → Does patient have risk factors for hyperglycemia or hypoglycemia?
    - Yes → See Page 3
    - No → initiate basal bolus insulin therapy at 0.4 units/kg/day subcutaneous with 50% of TDD used for prandial fixed bolus (lispro) dosing and 50% used for basal (glargine) dosing (see Appendix A and B)
      - Assess insulin needs every 24 hours
      - Consider a no concentrated carbohydrate diet

### TREATMENT
- Are glucose levels ≥ 200 mg/dL after 48 hours?
  - Yes → Consult Endocrinology-Diabetes
  - No → Discharge planning:
    - Consider resuming home medications, as appropriate
    - For patients with hemoglobin A1c < 7.5%:
      - Follow up with primary care provider
    - For patients with hemoglobin A1c 7.5-9%:
      - Consult Diabetes Educator
      - Follow up with primary care provider or General Internal Medicine
    - For patients with hemoglobin A1c > 9%:
      - Consult Diabetes Educator
      - Arrange ambulatory referral to Endocrinology-Diabetes

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eGFR = estimated glomerular filtration rate
NPH = neutral protamine Hagedorn
TDD = total daily dose
TPN = total parenteral nutrition

1. Hold home insulin and oral hypoglycemic agents such as sulfonylureas (glibizide, glyburide, glimepiride, gliclazide), meglitinides (rapaglinide, nateglinide) and SGLT-2 inhibitors (canagliflozin, dapagliflozin, empagliflozin, etagliflozin). Generally, metformin and DPP-4 inhibitors (sitagliptin, linagliptin, saxagliptin) are safe to continue if renal and liver function are stable.

2. Calculation of total daily insulin taken at home: add the total units of all long acting (glargine, degludec, or detemir), intermediate acting (NPH), and short acting (lispro, aspart, glulisine, or regular) insulin in a typical 24 hour period

3. Risk factors for hyperglycemia include: ● New enteral feedings or TPN ● Post-operative status ● High dose steroids (see Page 3)

4. See Appendix C: Comparison of Hemoglobin A1c (%) with Fructosamine Level

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Inpatient Hyperglycemia - Adult

Note: Insulin dose adjustments should be made based on the individual patient’s glucoses. Refer to the Hypoglycemia Management algorithm, as indicated.

### ASSESSMENT

- **New enteral feedings or TPN**
  - Consult Endocrinology-Diabetes

- **High risk for hypoglycemia: acute or chronic renal failure or failure to thrive**
  - Initiate basal insulin (glargine) at 0.15 units/kg/day subcutaneous and supplemental sliding scale bolus insulin (lispro) subcutaneous (see Appendix A and B)
  - Assess insulin needs every 24 hours

- **High risk for hypoglycemia: poor nutritional status or oral intake, or NPO status for anticipated procedures**
  - Initiate basal insulin (glargine) at 0.2 units/kg/day subcutaneous and supplemental sliding scale bolus insulin (lispro) subcutaneous (see Appendix A and B)
  - Assess insulin needs every 24 hours

- **Post-operative status**
  - Initiate Post-Operative Insulin Basal Bolus order set (see Appendix B)
  - Assess insulin needs every 24 hours
  - If steroid use is anticipated on discharge, consider Endocrinology-Diabetes consult

- **High dose steroids**
  - Initiate basal bolus insulin therapy at 0.6 units/kg/day subcutaneous with 60% of TDD used for prandial fixed bolus (lispro) dosing and 40% used for basal (glargine) dosing (see Appendix A and B)
  - Assess insulin needs and steroid dosing every 24 hours
  - If steroid use is anticipated on discharge, consider Endocrinology-Diabetes consult
  - Consider a no concentrated carbohydrate diet

### TREATMENT

- **Are glucose levels ≥ 200 mg/dL after 48 hours?**
  - Yes: Consult Endocrinology-Diabetes
  - No:
    - Discharge planning:
      - Consider resuming home medications, as appropriate
      - For patients with hemoglobin A1c < 7.5%:
        - Follow up with primary care provider
      - For patients with hemoglobin A1c 7.5-9.3%:
        - Consult Diabetes Educator
        - Follow up with primary care provider or General Internal Medicine
      - For patients with hemoglobin A1c > 9.3%:
        - Consult Diabetes Educator
        - Arrange ambulatory referral to Endocrinology-Diabetes

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1. High dose steroid therapy is considered to be ≥ 8 mg of dexamethasone, 50 mg of prednisone, 40 mg of methylprednisolone or 200 mg of hydrocortisone per day
2. If this is a recurrent admission for chemotherapy containing steroids, please check last Endocrinology-Diabetes note for more specific insulin dose recommendations and use if appropriate
3. See Appendix C: Comparison of Hemoglobin A1c (%) with Fructosamine Level

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**ASSESSMENT**

- Consult Diabetes Educator
- Consult Endocrinology-Diabetes

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**PRESENTATION**

- No history of diabetes
- Is patient on high dose steroid therapy\(^1\)?
  - No
  - Yes
    - No
    - Yes

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**TREATMENT**

- Consult Diabetes Educator
- Consult Endocrinology-Diabetes

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\(^1\) High dose steroid therapy is considered to be \(\geq 8\) mg of dexamethasone, \(50\) mg of prednisone, \(40\) mg of methylprednisolone or \(200\) mg of hydrocortisone per day

\(^2\) See Appendix C: Comparison of Hemoglobin A1c (%) with Fructosamine Level

\(^3\) Checkpoint inhibitors: nivolumab, pembrolizumab, durvalumab, atezolizumab, and related drugs. Patients with recent exposure to checkpoint inhibitors are at risk for DKA and should be evaluated for possible new onset type 1 diabetes mellitus.
APPENDIX A: Common Insulin Types and Frequency

<table>
<thead>
<tr>
<th>Fast Acting Insulin</th>
<th>Dose Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lispro (Humalog&lt;sup&gt;®&lt;/sup&gt;)</td>
<td>Before meals or every 4 hours</td>
</tr>
<tr>
<td>Aspart (Novolog&lt;sup&gt;®&lt;/sup&gt;)</td>
<td>Before meals or every 4 hours</td>
</tr>
<tr>
<td>Regular insulin (Novolin&lt;sup&gt;®&lt;/sup&gt;-R/Humulin&lt;sup&gt;®&lt;/sup&gt;-R)</td>
<td>Before meals or every 6 hours</td>
</tr>
</tbody>
</table>

Long Acting Insulin

| Glargine (Lantus<sup>®</sup>/Basaglar<sup>®</sup>/Toujeo<sup>®</sup>) | Daily or every 12 hours |
| Determir (Levemir<sup>®</sup>) | Daily or every 12 hours |
| Degludec (Tresiba<sup>®</sup>)<sup>1</sup> | Daily |

Intermediate Acting Insulin

| NPH (Novolin<sup>®</sup>-N/Humulin<sup>®</sup>-N) | Every 12 hours |

Mixed Insulin

| 70/30, 75/25<sup>1</sup>, 50/50<sup>1</sup> (mixes of NPH and a fast acting insulin) | Every 12 hours or every 6 hours with continuous tube feedings |

<sup>1</sup> Not currently on MD Anderson Formulary

APPENDIX B: Basal Bolus Insulin Terms

- **Bolus** insulin refers to a dose of fast acting insulin. This is typically comprised of **prandial** insulin which is scheduled to compensate for the carbohydrate content of a meal and **supplemental** (or sliding scale) insulin to correct hyperglycemia. Bolus insulin is most effective when given before meals, but supplemental insulin alone can be scheduled for patients who are not eating or are high risk for hypoglycemia.

- **Basal** insulin refers to a dose of long acting insulin given 1 or 2 times daily. These insulins absorb slowly to help maintain stable glucose levels.

- **Supplemental** insulin is based on either weight or total daily insulin requirement.

- A **basal/bolus** insulin regimen uses both types of insulin to recreate a physiologic pattern of insulin release. This regimen is more effective for most patients than sliding scale supplemental insulin only. Most patients need about half of their insulin as basal and half as bolus. Patients on high doses of steroids will often need more bolus insulin.

APPENDIX C: Comparison of Hemoglobin A1c (%) with Fructosamine Level

<table>
<thead>
<tr>
<th>Hemoglobin A1c (%)</th>
<th>Fructosamine Level (µmol)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>287.5</td>
</tr>
<tr>
<td>7.5</td>
<td>306.25</td>
</tr>
<tr>
<td>8</td>
<td>325</td>
</tr>
<tr>
<td>9</td>
<td>362.5</td>
</tr>
</tbody>
</table>

Note: Each 2% change in hemoglobin A1c represents an approximate 75 µmol change in fructosamine
SUGGESTED READINGS


Inpatient Hyperglycemia - Adult

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